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RCT Continuing Training: 4th Quarter 2021 Presentation Transcript

Slide #1.1 – 2021 4th Quarter Continuing Training

Slide #1.2 – Introduction

"Welcome to RCT Continuing Training, fourth quarter twenty, twenty-one. This quarter's training consists of two parts, viewing this online lecture and completing the associated exercise guide. In this presentation, we will review the different requirements for performing radiation and contamination surveys at LANL and how to document them. The exercise guide is available on UTrain, and was also sent out for the quarterly notification for Continuing Training. It is recommended that you have the exercise guide with you while following along with this training."

Slide #1.3 – Terminal Objectives

"The terminal objectives covered for this quarter's continuing training are the following: Given the need to perform radiation surveys, recognize the requirements of an RCT in accordance with P121, *Radiation Protection* and RP-PROG-TP-200, *Radiation Protection Manual*. And… Given the need to perform contamination surveys, recognize the requirements of an RCT in accordance with P121, *Radiation Protection* and RP-PROG-TP-200, *Radiation Protection Manual*."

Slide #1.4 – Enabling Objectives

"The enabling objectives that will be discussed over the course of this training include: identify how to perform shallow dose evaluations, calculate the sum of all radiations, explain how to perform radiation surveys, explain how to perform contamination surveys, discuss how to perform field screens of contamination smears, and demonstrate documenting radiological surveys"

Slide #1.5 – Radiological Surveys

"Radiation and contamination monitoring is the foundation for a strong RP Program. For example, a thorough understanding of radiological surveys serves as the basis for other tasks such as item release and job coverage. Inadequate surveys lead to: the release of radioactive material to the public, personnel contamination events, radiological posting violations, and over-exposure incidents. As an RCT, it is your responsibility to not only know how to perform these surveys, but to also process and understand the information being observed."

Slide #1.6 – Radiological Characteristics Review

"Prior to performing surveys, an RCT should understand the fundamentals of radiation and how it interacts with matter. Understanding the fundamentals allows RCTs to better recognize what is being surveyed and gives them the ability to anticipate changes.

Before we go over how to conduct radiological surveys, let's review the different radiological characteristics of alpha, beta, gamma, and neutron radiation."

Slide #1.7- Alpha Radiation

"Alpha radiation has the makeup of a helium nucleus, consisting of a positive particle with two protons and two neutrons. Alphas are typically produced from heavy nuclei reactions, such as from plutonium. Alphas do not pose a significant external radiation hazard due to their ability to easily be shielded and low travel distances. However, if taken into the body, alphas can produce substantial damage because of the high probability of interaction between an alpha particle and the orbital electrons of the absorbing. Due to the +2 charge, a large number of ion pairs are formed per unit path length as the alphas interact. Materials like paper and the unbroken layer of dead cell layer of skin can shield alpha radiation. Typically, alphas will only carry along for a short distance of 1 to 3 centimeters."

Slide #1.8 – Beta Radiation

"Beta radiation is formed from charged, fast-moving electrons or positrons. These are produced from the nucleus of unstable isotopes. Cs-137 and Strontium-90 are both examples of beta emitters. Betas have a longer range than alphas, but cause less internal biological damage compared to alpha radiation. But they do pose a concern for shallow dose exposure. High energy beta radiation can potentially create skin burns. Low density and Z materials such as rubber and plastic are effective at shielding betas. Using a high Z material in an attempt to shield beta radiation can lead to Bremsstrahlung radiation to occur. Beta travel ranges are energy dependent at approximately four meters per MeV."

Slide #1.9 – Gamma Radiation

"Gamma radiation, sometimes referred to as high energy photons, are fast-moving packets of high-energy radiation with no mass or charge. Due to their absence of mass and charge, gammas have an extremely long range in air. While traveling in air, gammas can reach distances over hundreds of meters Cobalt-60 and Iodine-131 are gamma emitters commonly found in the commercial nuclear power industry. They cause significant risk to produce biological damage. One way to reduce the intensity of gamma radiation is through the use of high Z and dense materials. Lead blankets are an example of a quick and efficient tool for gamma shielding. While traveling in air, gammas can reach distances over hundreds of meters".

Slide #1.10 – Neutron Radiation

"Neutron radiation can be defined as free traveling, thermal, slow, or fast neutrons that can be produced from nuclear fission. Neutron radiation can travel great distances, with a very high penetrating ability. Neutrons are the only type of radiation with the ability to cause materials to become radioactive, known as neutron activation. Hydrogenous materials such as water or polyethylene are needed to slow-down or moderate the neutrons while a capture material is used for absorption. If left unshielded, neutrons can travel hundreds to thousands of meters in air."

Slide #1.11 – Lesson Learned

"Radiological surveys are routine tasks that an RCT should not take for granted. Every time a survey is performed RCTs should maintain a questioning attitude and have a full understanding on the expectations of the job. We will discuss a lessons learned event that took place which resulted in an exposure event due to a few key contributing factors. Poor work planning, inadequate response to dose rate reading discrepancies, and departures from work control documents resulted in unplanned extremity exposure to three workers.

In July 2009 a sample containing Arsenic-73, a gamma emitter and Arsenic -74, a beta and gamma emitter, prepared in the Hot Cell facility at TA 48 Building 1 was removed from the facility shielding and placed behind shielded glass on the dilution bench to be decontaminated and packaged for shipping to TA-53."

Slide #1.12 – Summary 2 of 4

"The hazards and controls established for the source were as documented in the existing IWD and were expected to be the same as other sources routinely worked with in the hot cell area. However, the source created a highly directional source of beta radiation and was not contained in solution, as is normally required per the IWD. The change in hazard was not recognized by all participants in the work activity. The initial dose rate measured as the sample emerged from the Hot Cells at TA-48 was 4 R/hr at 30 cm, within the RWP limit of 5 R/hr at 30 cm."

Slide #1.13 – Summary 3 of 4

"The lead chemist placed it in the lead shipping pig, where another dose rate reading at the mouth of the pig indicated 30 R/hr at 30 cm. Although the sample was packaged safely for shipping this dose rate discrepancy was not fully documented. The sample was shipped to TA-53 where the container and the lead pig holding the sample were surveyed for dose rate and contamination. The contamination survey was negative and the external dose rate survey with the pig lid open indicated 5 R/hr beta/gamma and 1 R/hr gamma at 30 cm."

Slide #1.14 – Summary 4 of 4

"The gamma dose rate was within the RWP limits at TA-53, although the beta dose rate limit was not defined, and the work team proceeded with mounting the sample in the ion chamber. As the mounting process neared completion, another dose rate measurement indicated 30 R/hr at 30 cm. The work team members agreed that to make the situation safe while minimizing additional exposure, the mounting should be completed and the ion chamber cover put in place. Two researchers received doses to their extremities while installing the sample and assembling the ion chamber. A subsequent dose assessment indicated beta doses of 26 rem and 19 rem to the extremities."

Slide #1.15 – What Caused This to Occur?

"Here are some of the contributing factors which allowed this event to occur: inadequate work planning, RWP discrepancies between the different facilities handling the source, insufficient response to dose rate discrepancies, not enough communication from SMEs and RCTs, and lack of a questioning attitude.

Preventative actions were determined following this event to include: the use of a job specific RWP, work control documents should be coordinated or cross examined to ensure consistency, concerns are raised when violations in the RWP are discovered, clear communications between all work groups must be established, and critical thinking. To view the full report of this lessons learned, click on the link at the bottom of the screen".

Slide #1.16 – Types of Radiological Surveys

No Narration

Slide #1.17 – RP Changes and Upcoming Information

"Now we will briefly go over some of the recent changes and upcoming information in the RP department. In September a new revision of RP-PROG-TP-200 was released. The changes as shown here include updated tritium smear guidance, clarified RSSDMS email frequencies for RSS inventories and leak checks, clarified RGD events requiring an RPIN, and an update on RP organization names.

Given recent feedback from RP personnel in the field, a new online training has been developed and has been made available to the RCTs. This training will provide an overview of the RCT continuing program and what steps RCTs should take to ensure they remain eligible for requalification. An email will be sent out containing the information on when and how to go over this lesson."

Slide #1.18 – Conclusion

"Congratulations! You have successfully completed the online portion of RCT Continuing Training. To receive credit for RCT Continuing Training: 4th Quarter 2021, you must now complete the Student Exercise Guide that has been provided to you. Once finished, email a copy of the completed guide to RP-Training@lanl.gov. Credit will be assigned for the exercise guide by the end of the quarter."

Slide #2.1 – Performing Radiation Surveys

"Radiation surveys are necessary to determine dose rates of specific material, objects, and locations. As an RCT, it is your job to process this information and take appropriate actions as required by LANL RP procedures. Types of responses may include pausing/stopping a job, changing a radiological posting, having workers move to a different location, or notifying an HPFC on trending dose rates. Being able to analyze the readings on your instrumentation can help prevent radiological incidents from occurring."

Slide #2.2 – Instrument Characteristics

Part 1

"Now let's review the some of the different characteristics of instruments found along the gas amplification curve. Use the slider below to scroll through the different regions."

Part 2

"Ion Chambers. This type of detector is very useful in the radiation protection industry, with the RO20 being one of the most common instruments used by RCTs. Advantages of ion chambers include being less expensive and more portable than other types of detectors,   having a response that is directly proportional to dose rate,   and when being used for photon radiation yielding a true exposure rate.

Disadvantages can be that smaller ion chambers have a poor sensitivity due to the low amount of current produced when only a few ionizing events per minute are occurring,   they are affected by humidity,   and changes in altitude and temperature can lead to inaccurate readings. To account for any altitude changes, a correction factor chart is included in attachment 1 of RP-SOP-46, the Eberline RO20 Ion Chamber procedure."

Part 3

"Proportional detectors. These instruments are very important for radiation protection monitoring and are used frequently at LANL. Personnel Contamination Monitors, Tennelecs, and REM balls are some different examples of proportional detectors. Advantages include: they can discriminate different types of radiation, more sensitive, and output signal is proportional to the dose rate. Some disadvantages of proportional detectors are that they are sensitive to high voltage changes due to the effects of the gas amplification factor, and more highly regulated power supplies are needed."

Part 4

"Geiger-mueller detectors. Advantages of this type of detector are that they are more sensitive than air proportional detectors and ion chambers, not affected by temperature and pressure, and they require less highly regulated power supplies. A few disadvantages of GM detectors are that their responses are not related to the energy deposited. Therefore, the readings cannot be used to measure true dose rate. If using a GM detector for surveys such as posting or shipping limit verifications, a follow-up survey with an RO-20. Geier-mueller detectors do not have the ability to discriminate against different types of dose rate. An example of a GM detector that can be found on site is the teletector."

Slide #2.3 – Instruments Used at LANL

"Using the correct instrument for the job is essential while performing radiation surveys. This was demonstrated in the lessons learned by not accounting for the beta contributions.
When choosing an instrument, determine the types of radiation expected in the area. There may be times where multiple detectors are necessary for the job being covered. An RCT should also have an understanding on how their instrument works and any limiting conditions that may come along with it. Examples of some limiting conditions are the energy ranges detectable for an instrument, how other types of radiation may affect the accuracy of the readings, and

temperature or pressure variations, such as mentioned previously with the RO-20. Here are some different examples of instruments that can be used for certain radiation types”

Slide #2.4 – External Radiation Surveying Requirements

“RP-PROG-TP-200, section 1521 states the times when a radiation survey is required to be performed. These are: Before, during, and after work that involved the potential for significant changes in the levels of radiation, upon entry into an HRA, for initial posting or posting changes, to support work, including RMIs, RWP hold points, and as requested”.

Slide #2.5 – External Radiation Surveying Requirements continued

“More general requirements from RP-PROG-TP-200 include: when a source has been exposed and then secured or shielded to verify that the very high radiation field has been terminated. When a radiation generating device (RGD) has been de-energized to verify that the high or very high radiation field has been terminated. Whenever personnel may be exposed to small intense beams of radiation, such as those generated by unshielded x-ray devices. When surveying in contaminated areas, take steps to prevent contamination of the survey instrument, such as by placing the instruments in plastic bags. If performing an external radiation survey in an HRA or VHRA, then ensure required instrument checks are conducted prior to entry.”

Slide #2.6 – Distances for External Radiation Surveys

“Depending on the type of radiation survey being performed, there may be certain distances from the source where the survey needs to be performed. These different locations include the general area, 30 centimeters, and an on-contact survey. Let’s discuss why these types of surveys may be required. ”

“General area surveys are taken at distances approximately three feet above the floor. These are the most common types of surveys an RCT will take. The GA readings can be used to help determine RWP limits, stay-times, and expected dose received for specific jobs.”

“Performing radiation surveys at a distance of 30 centimeters is required when posting a radiation area or high radiation area. These readings can also be helpful when determining work area dose rates near an object, such as piping or a valve. Similar to on-contact readings, these are required for HPRMS tags."

"An on-contact survey is needed when hands-on work is being conducted with radioactive material. HPRMS tags also require an on-contact reading to be performed. This survey is an effective method in finding small localized areas of radiation."

Slide #2.7 – Knowledge Check

Slide #2.8 – Answer Key

Slide #2.9 – RO-20 Contact External Radiation Surveys

"RP-PROG-TP-200, Section 1521.4 states the requirements while performing an on-contact survey with an RO-20. If a contact dose rate for DU is required, then calculate the OW in mrem/hr using the following equation: Corrected open window in mrem/hr equals open window reading in mR/hr times 3, where 3 is the DU contact beta correction factor. If the contact reading does not involve DU, then contact the facility Health Physicist (HP) for a correction factor. If no correction is provided by the HP, then only record the uncorrected OW value in mR/hr."

Slide #2.10 – Shallow Dose Evaluations

"Shallow dose refers to the exposure received in living tissue, just below the dead layer of skin, at 7-mg/cm2. This dose, as well as deep dose exposure, which is 1000-mg/cm2, are used to determine the Sum of All Radiations (SAR). RCTs need to be aware of how and when to perform this type of survey. Failure to account for shallow dose can lead to possible posting violations or over exposure events. We will review when this type of survey is procedurally required to be taken, and the method to perform them."

Slide #2.11 – When to Perform SDEs

"RP-PROG-TP-200, Section 1521.2 Shallow Dose Evaluations. An evaluation of shallow dose contribution to the total radiation dose must be performed in the following situations:

Characterization surveys for new radioactive material activities or areas, re-characterization surveys for a radioactive material area/activity when changes have occurred in radioactive material type, quantity, configuration, location, or shielding, and posting surveys. A shallow dose evaluation is not required to be calculated for area/activity surveys once a ratio for that area/activity has been established in a characterization survey, unless changes have occurred."

Slide #2.12 – How to Perform a SDE

"Shallow dose evaluations shall be performed with an RO-20 ion chamber open and closed window readings. Divide the open window reading by the closed window reading to obtain an OW/CW ratio. If the OW/CW ratio is ≥ 1.2, then beta radiation must be included in Sum of All Radiation calculations for the area/activity surveys. If the OW/CW ratio is < 1.2, then beta radiation is not included in SAR calculations and only the closed window RO-20 reading is used. Let's now walk though how this process would take place. To begin, perform a closed window survey by ensuring the mylar is covered. Next, perform your survey and wait for your counts to stabilize. In this example here we see a result of 1.6 mR/hr. Following this you will perform an open window reading at the same location. Ensure there are no punctures in the mylar. Obtain your reading. Here we have an open window reading of 1.8 mR/hr. Now it is time to get your ratio. Example # 1. Open window is 1.8 mR/hr and closed window reading was 1.6. Now we perform our ratio of 1.8 divided by 1.65, which gives us 1.125. The open window over closed window ratio is less than 1.2. Therefore beta radiation is not included in the Sum of All Radiations equation. Now we will try another example with an open window reading of 2.5 mR/hr. Using the same process as before, it will be open window divided by closed window, which is 2.5 over 1.6. This results in 1.56. The ratio is greater than 1.2 which means beta radiation will be included while calculating the sum of all radiations."

Slide #2.13 – Sum of All Radiations Equations

"IF the open window/closed window ratio is < 1.2, then calculate the SAR using the equation closed window reading plus the neutron dose rate, if there is any neutron radiation present. Remember, a ratio of less than 1.2 tells us that beta radiation is not significant enough to attribute towards the total radiation in that area. If the ratio is equal to or greater than 1.2, then beta radiation is contributing to the sum of all radiations. The equation for this sum of all radiations is open window reading minus the closed window reading times 2.5, plus the closed window reading and any neutron dose rates. The 2.5 is the beta correction factor. These equations are required to be known while documenting radiation survey results.”

Slide #2.14 – OW/CW <1.2 Example

“Here is an example of calculating the sum of all radiations after obtaining all of your dose rates. The closed window reading is 1.2 mR/hr, open window is 1.3 mR/hr, and a neutron dose rate of 2.2 mrem/hr. First off, we will need to get our ratio to determine what SAR equation to use. Open window over closed window is 1.3 divided by 1.2, which equals 1.08. This is less than 1.2, so the equation we will use is closed window plus neutron dose rate. The sum of all radiations is then 1.2 plus 2.2, to get a total of 3.4 mrem/hr.”

Slide #2.15 – OW/CW >1.2 Example

“Now we will try a scenario with readings of 18 mR/hr closed window, 26 mR/hr open window, and 8 mrem/hr for neutron radiation. Just like the last example, we will first find our open window/closed window ratio. To get this, we divide 26 over 18, to get 1.44. This is greater than 1.2, so we will use the SAR equation which accounts for beta radiation. That equation is open window minus closed window, time 2.5, plus the closed window reading and neutron dose rate. So we will subtract 18 from 26 to get 8. This is then multiplied by the beta correction factor of 2.5, which results in 20. Now you add the closed reading of 18 and the neutron dose of 8 to get a total of 46 mrem per hour.”

Slide #2.16 – SAR Applications

“Determining the Sum of All Radiations is necessary for the following situations: establishing postings, radioactive material shipments, general area dose rates, work area dose rates, down-posting surveys, and dose investigations. Failure to account for all sources of radiation, such as beta dose or neutrons, can lead to inaccurate results and regulatory violations. RCTs must have an understanding of the radiological conditions they are working in, and always have a questioning attitude to ensure violations do not occur.

Slide #2.17 – Radiation Limits of Concern

"The Sum of All Radiations is used for posting classifications at LANL. Table 7-3 in P121 lists the criteria for posting external radiation hazards. Let's review some of these posting limits. The criteria for a radiation area is when the dose rates are greater than or equal to 5 mrem/hr at 30 cm from the source to less than 100 mrem/hr. A high radiation area with caution controls is when levels are greater to or equal 100 mrem/hr at 30 cm to less than 1000 mrem/hr at 30 cm. A danger high radiation area is when the dose rates at 30 cm are greater than or equal to 1000 mrem/hr. As an RCT these limits should always be considered while performing radiation surveys."

Slide #2.18 – Knowledge Check

Slide #3.1 – Performing Contamination Surveys

"Contamination is defined as radioactive material in an unwanted location. Surveys are performed to detect and quantify any presences of contamination on an object. These are required for situations such as monitoring personnel and items out of radiological controlled areas, shipping of radioactive material, job coverage, and much more. RCTs are expected to know the requirements of when and how to properly perform contamination surveys. Understanding LANL procedures and radiological principles will help achieve this."

Slide #3.2 – Contamination Control General Requirements

"Attachment 14, of RP-PROG-TP-200, states the requirements of an RCT for contamination control are the following: Perform contamination surveys in accordance with RP-PROG-TP-200 and associated procedures, monitor work operations to prevent the spread of contamination into areas that are outside radiological control boundaries, complete surveys as soon as practical, but no later than one working day after results are available, and to notify the HPFC and appropriate facility personnel of any unusual survey results or conditions."

Slide #3.3 – Contamination Instruments Used at LANL

"When performing contamination surveys, choosing the correct instrument for the job is critical. An RCT will need to understand what they are surveying to verify all types of contamination are accounted for. This is especially important when performing release surveys. Using just an instrument that only detects alphas, such as the Ludlum 139, is not sufficient for a free release. This is because it cannot detect other possible types of contamination and does not have the ability to detect activities below P121 table 14-2, surface contamination values. Here are some of the different contamination instruments used at LANL."

Slide #3.4 – Surface Contamination Values

"Table 14-2 of P121 establishes surface contamination thresholds for use in area designation, posting, and control and for item removal from radiological areas, RBAs, and RCAs. This table incorporates 10 CFR 835, Appendix D, DOE O 5400.5, Figure IV-1, and subsequent DOE guidance regarding transuranic values. An RCT should be able to know where to find this table and what times they should need to reference it while performing contamination surveys."

Slide #3.5 – Types of Contamination

"The two different types of contamination are removable, or loose, contamination and fixed. Removable (loose) surface contamination is easily transferred to personnel or equipment through normal contact. Removable contamination is measured by a transfer test using a suitable sampling material. Common materials used are the standard paper disk smear or cloth smear. Fixed surface contamination is not easily transferred through normal contact, and is measured using a direct survey technique (frisking). Frisking measures both fixed and removable contamination. When non-removable levels are recorded, the loose contamination level must be subtracted from the total."

Slide #3.6 – Removable-Quantitative

"Quantitative surveys are used to determine removable contamination levels. The units of concern for regulatory requirements are disintegrations per minute, dpm, over an area of 100 cm2. This can be obtained by performing a disk smear in an 8 inch 'S' pattern, the size of a dollar bill, or a 4 by 4 inch square. The shape of the smeared area may vary based on the item being surveyed. A smear should always be taken in one continuous motion with light to moderate pressure. This should be done in such a way that results are accurate and reproducible."

Slide #3.7 – Disk Smears

"When using disk smears, ensure you perform the following: number the smears, wear gloves while performing the survey, even if contamination is not expected, survey from lowest to highest potential of contamination, treat all used smears as potentially contaminated until verified otherwise, separate used smears from clean ones by placing them in a plastic bag, and perform frequent glove changes and hand surveys to prevent cross contamination."

Slide #3.8 – Tritium Smears

"Another type of contamination survey that may be required dependent on your facility is tritium smears. RP-PROG-TP-200, section 1411.1.1 provides guidance on how to conduct this type of survey. Place an unused tritium smear in sample vial number 1, and mark according to facility processes. IF using 20-mL vials, THEN prepare each vial by adding 1-mL of deionized (DI) water to each vial. IF using "pony" vials (8-mL to 10-mL), THEN add 0.5 mL of DI water and 5 mL of UltimaGold/fluor. Record the blank sample in space number 1 of the survey form. In one continuous motion, wipe an area approximately 100 cm2 with the survey media. Immediately place the tritium smear in a numbered or labeled vial. Place an unused/blank tritium smear in every tenth vial (e.g., 11, 21). Record "blank" on the survey form for unused/blank tritium smears. IF the samples will be sent to HPAL for analysis, THEN screen/estimate the samples to determine whether HPAL notification or shipping limits have been exceeded."

Slide #3.9 – Removable Qualitative

"Qualitative surveys are used to determine if contamination is present but cannot be used to quantify the contamination levels, sometimes used as a Go/No-Go test. Common materials used for large area wipes are Masslinn cloths. Large-area swipes, or LASs are used for qualitative surveys and detect any presence of contamination over large areas. The table seen here provides guidance on some of the recommended areas and frequencies LASs should be performed, typically in areas where contamination is not expected to be present. These are then counted directly with an appropriate instrument to indicate the presence of contamination. If contamination above the MDA/DL is found, follow-up disk surveys should be performed to quantify the contamination"

Slide #3.10 – Large Area Smears

"When performing an LAS, the following items should be considered: Number the LAS if multiple are going to be taken, inspect the mop and replace any old survey material prior to use, maintain the same leading edge while performing the survey. This prevents spreading any contamination around and helps give a more accurate representation of the area being surveyed, do not survey the LAS while still attached on mop head due to any potential contamination embedded in the mop giving false indications. Do not place mop near the face or head due to potential intake of contamination. Completely open up the LAS to perform the survey, to ensure nothing is missed. Small particles may be shielded of hidden if not fully opened while surveying the LAS."

Slide #3.11 – Direct Contamination Surveys

"Direct surveys, or frisks, are performed to get the total contamination of an object, which is the combined removable and fixed levels. The frisk needs to be performed at a speed of 1-2" per second, and a distance of 1/4" from the object. This speed is necessary for the detector to have enough time to process the counts that are entering it. Remember, some instruments have a long response time, and moving the probe too fast can potentially lead to the instrument not detecting the contamination. It is also important for the detector to be within 1/4" from the object to get an accurate reading. If it is too far away, it will not pick up the short distance traveling alphas."

Slide #3.12 – Units for Direct Frisking

"Direct frisks are recorded in dpm/100cm2. As shown in the chart above, there will be times when the detector is smaller than 100cm2. In order to account for this, a probe area correction factor will need to be used. If the detector being used is less than 100 cm2 and the area surveyed is less than the detector surface area, then the units are dpm/100cm2 with no area correction needed. If the detector is less than 100 cm2 and the area surveyed is greater than the detector surface area, the units are also dpm/100cm2 with a probe correction factor needed to be used. If the probe area equals 100 cm2, the units are dpm/100cm2 with no area correction needed."

Slide #3.13 – Probe Correction

"If a probe correction is needed, as determined from the chart in the previous slide, the equations below can be used. To convert counts per minute to disintegrations per minute, multiply the cpm by the instruments calibration correction factor. Another way to get the calibration correction factor is to divide one over the instrument efficiency. To convert your dpm/probe area to dpm/100cm2 you will need to divide it over the fraction of your probe surface area over 100. Let's walk through an example using some of these equations.

A survey of a desk is performed using a Ludlum 139 with a 43-32 detector. The meter reads a net count of 300 cpm/probe area. What is this in dpm/100cm2? The probe area for the 43-32 detector is 76cm2 with a calibration correction factor of 2. First off, we will need to convert the cpm to dpm. To do this, we will need to multiply the 300 cpm by the calibration correction factor. So 300 cpm times 2 will give us 600 dpm. Now we need to account for the probe area being less than 100cm2. This is done by dividing the 600 dpm by the probe area over 100. The probe area was 76cm2, so 76 divided by 100 equals .76. 600 dpm over .76 results in a total of 789 dpm/100cm2. This example demonstrates how much results can vary if a probe correction is not performed when needed."

Slide #3.14 – Common LANL Contamination Probes

"Here are some examples of different contamination probes found at LANL. The Ludlum 43-93 is a dual alpha-beta scintillator with a probe area of 100 cm2. This would not require a probe correction factor to be performed. The HP-260, which can be found on the ESP-1, is a Geiger Mueller detector, that has a probe surface area of 15 cm2. The Ludlum 43-32, used with the Ludlum 139, is a proportional detector, used for alpha contamination with an area of 76 cm2. These last two types of detectors would require a probe correction factor is performed using a direct frisk over an area greater than their respective detector surface areas."

Slide #3.15 – Knowledge Check

Slide #3.16 – Contamination Survey Instructions

“RP-PROG-TP-200, section 1411.1.1 states the following contamination survey instructions: If the area is contaminated, then make appropriate notifications to the HPFC and facility management. Help determine whether the area needs to be decontaminated. After the area is decontaminated, re-survey the area, and evaluate the results to verify successful decontamination. If an instrument has an audible feature, then the audible feature must be used. NOTE: Headsets facilitate the use of audible features in high noise areas. Treat all used smears as potentially contaminated until verified otherwise.”

Slide #3.17 – Contamination Survey Instructions continued

“If performing direct and removable contamination surveys together, then perform the direct surveys before the removable. Contamination surveys are performed with dry media, even when used on wet surfaces. CAUTION - All smears must be dry before being counted, except in certain cases for tritium smears. Releasing an area or facility from contamination or airborne radioactivity status to radiologically controlled area status requires that the area be thoroughly surveyed by radiological control personnel. Contamination must be less than the limits specified in P121 Table 14-2. Areas released from contamination status must be decontaminated to a level as far below the allowable release limits as practical.”

Slide #3.18 – Field Screening

“Prior to submitting smear samples a field screen should be conducted. This is done to verify: HPAL notification/shipping limits have not been exceeded, postings are sufficient, RWP suspension limits have not been met, and no abnormalities exist for scope of work. Due to the accuracy limitations of portable contamination detectors, smears should still be sent to HPAL or placed in a counter such as a Tennelec or Berthold following field checks. Dose rates may not allow for field screens to be performed in the work location, but they should be conducted in an area of lower background as soon as practical.”

Slide #3.19 – Contamination Survey Best Practices

"If the contamination type is unknown, then contact an HPFC for guidance on selecting the proper instrument and surveying techniques. The following must be considered when performing contamination surveys: characteristics of the radiation hazards, size of the area or facility, operations conducted in the area, potential for contamination, ventilation flow patterns, and contamination history. Contamination surveys should include enough points to adequately characterize the area being surveyed. Contamination surveys should be performed before, during, and at the completion of work, or at any time when a radiological condition change is likely to occur."

Slide #4.1 – Documenting Radiological Surveys

"We will now walk through the process for filling out an RP-PROG-FORM-114, *External Radiation/Contamination Form*. The following video will cover a scenario where a pre-job survey is performed and the field data obtained will be transferred to the survey form. Reference the survey map provided in the link shown while following along. This survey data can also be found in the initial email notification sent out. Click on the play video button to begin."